

MARIANA FRUIT BAT (Guam Population)

AND

LITTLE MARIANA FRUIT BAT

RECOVERY PLAN

Published by
U.S. Fish and Wildlife Service
Portland, Oregon

**GUAM MARIANA FRUIT BAT
AND
LITTLE MARIANA FRUIT BAT**

RECOVERY PLAN

Prepared by Gary J. Wiles
Division of Aquatic and Wildlife Resources
Department of Agriculture
Government of Guam
Agana, Guam

for
Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: Don Weather
ACTING Regional Director, U.S. Fish and Wildlife Service

Date: 11/2/90

THIS IS THE COMPLETED GUAM FRUIT BATS RECOVERY PLAN. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVALS OF COOPERATING AGENCIES, AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL INDIVIDUALS INVOLVED IN THE PLAN FORMULATION. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES, AND OTHER BUDGETARY CONSTRAINTS.

Literature Citation: U.S. Fish and Wildlife Service. 1990. Guam Mariana Fruit Bat and Little Mariana Fruit Bat Recovery Plan. Portland, Oregon. 63 pp.

ADDITIONAL COPIES MAY BE OBTAINED FROM:

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814
301-492-6403
1-800-582-3421

EXECUTIVE SUMMARY OF THE MARIANA FRUIT BAT RECOVERY PLAN

Current Status: Both species are listed as endangered. By 1948 biologists found the bat to be uncommon in northern Guam and by 1984, it was estimated that there were 425 to 500 Mariana fruit bats left. The little Mariana fruit bat may be extinct.

Habitat Requirements and Limiting Factors: Fruit bats forage and roost in mature, native limestone forest and ravine forest. Illegal colony hunting and predation of young by the brown tree snake are the most serious threats.

Recovery Objectives: Downlisting of Mariana fruit bat. None set for little Mariana fruit bat.

Recovery Criteria: Increase Mariana fruit bat population to at least 2,500 with a minimum of three permanent colonies with each colony supporting at least 400 bats.

Actions Needed:

1. Eliminate illegal hunting.
2. Control brown tree snake and other exotic predators.
3. Conduct research on biology of the species.
4. Conduct necessary management activities at existing locations.
5. Reintroduce bats and verify/determine recovery objectives.

Total Estimated Cost of Recovery:

Costs: (000's)

<u>Year</u>	<u>Need 1</u>	<u>Need 2</u>	<u>Need 3</u>	<u>Need 4</u>	<u>Need 5</u>	<u>Total</u>
1986	122.5	439.0	95.0	0	10.0	666.5
1987	112.5	439.0	95.0	0	10.0	656.5
1988	112.5	379.0	95.0	0	10.0	596.5
1989	112.5	379.0	95.0	0	10.0	596.5
1990	112.5	379.0	95.0	0	10.0	596.5
1991	112.5	379.0	205.0	115.0	10.0	821.5
1992	112.5	379.0	172.0	132.0	10.0	805.5
1993	112.5	379.0	178.0	153.0	10.0	832.5
1994	112.5	214.0	109.0	105.0	144.5	685.0
1995	112.5	214.0	74.0	105.0	101.0	606.5
1996	110.5	54.0	48.0	60.0	48.0	320.5
1997	110.5	54.0	48.0	60.0	43.0	315.5
1998	110.5	54.0	48.0	60.0	43.0	315.5
1999	110.5	54.0	48.0	60.0	43.0	315.5
2000	110.5	54.0	48.0	60.0	43.0	315.5

Total

<u>Cost</u>	1687.5	3850.0	1433.0	910.0	545.5	8426.0
-------------	--------	--------	--------	-------	-------	--------

Date of Recovery: Downlisting should be initiated in 2000, if recovery criteria have been met.

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION.....	1
A. Brief Overview.....	1
B. Location.....	3
C. Species Descriptions.....	4
D. Past and Present Status.....	4
E. Habitat Requirements.....	7
Habitat Use.....	7
Food Habits.....	8
Activity Patterns and Movements.....	8
Social Organization and Reproduction.....	10
F. Reasons for Decline.....	12
Overhunting/Poaching.....	12
Habitat Destruction.....	13
Predation.....	14
Typhoons.....	16
G. Conservation Measures Already Taken.....	16
Status, Distribution and Life History Studies....	16
Protection and Law Enforcement Measures.....	17
Protected Areas.....	17
Public Education.....	21
II. RECOVERY.....	23
A. Objective.....	23
B. Narrative.....	24
D. Literature Cited.....	39
III. IMPLEMENTATION SCHEDULE.....	43
IV. APPENDIX A - Essential Habitat.....	A1
V. APPENDIX B - Individuals Contacted during Technical Review.....	B1
VI. APPENDIX C - Agencies Contacted During Agency Review.....	C1

LIST OF FIGURES

<u>Number</u>	<u>Page</u>
1. Map of the Mariana Islands in the Western Pacific Ocean.....	2
2. Distribution of Mariana fruit bats on Guam based on sightings of bats made from 1983 to 1985.....	6
3. Essential Habitat of Fruit Bats in Northern Guam.....	19
4. Essential Habitat of Fruit Bats in Southern Guam.....	20

RECOVERY PLAN FOR THE MARIANA FRUIT BAT AND LITTLE MARIANA FRUIT BAT

I. INTRODUCTION

A. Brief Overview

This plan describes recovery efforts for two species of fruit bats, the Mariana fruit bat (Pteropus mariannus mariannus) and the little Mariana fruit bat (Pteropus tokudae), native to Guam in the Mariana Islands. Both species are members of the Old World fruit bat family Pteropodidae and are known locally on Guam as "fanihi" (their Chamorro name). The Mariana fruit bat is one of six subspecies of P. mariannus found in Micronesia and the Ryukyu Islands (Kuroda 1938). In the Marianas, this bat occurs from Guam north to at least Saipan (Figure 1); a second subspecies, P. m. paganensis, has been described from Pagan and Alamagan (Yamashina 1932). The precise taxonomic status of the fruit bat populations on the remaining Mariana Islands north of Saipan, has not been determined. The little Mariana fruit bat is thought to be endemic to Guam and was first discovered in 1931 (Tate 1934). However, several hunters have recently reported independently that a small fruit bat occurs on Anatahan (T.O. Lemke 1985). Only three specimens of little Mariana fruit bat have been collected on Guam and almost nothing is known of its natural history. Because of the lack of information on the little Mariana fruit bat and the likelihood that this species may already be extinct, this plan deals mainly with Mariana fruit bat.

Both species of fruit bat were federally listed as endangered on August 27, 1984 (49 FR 33881-33885) (U.S. Fish and Wildlife Service 1984). However, only the Guam population of the Mariana fruit bat was included in the listing. Other populations of this

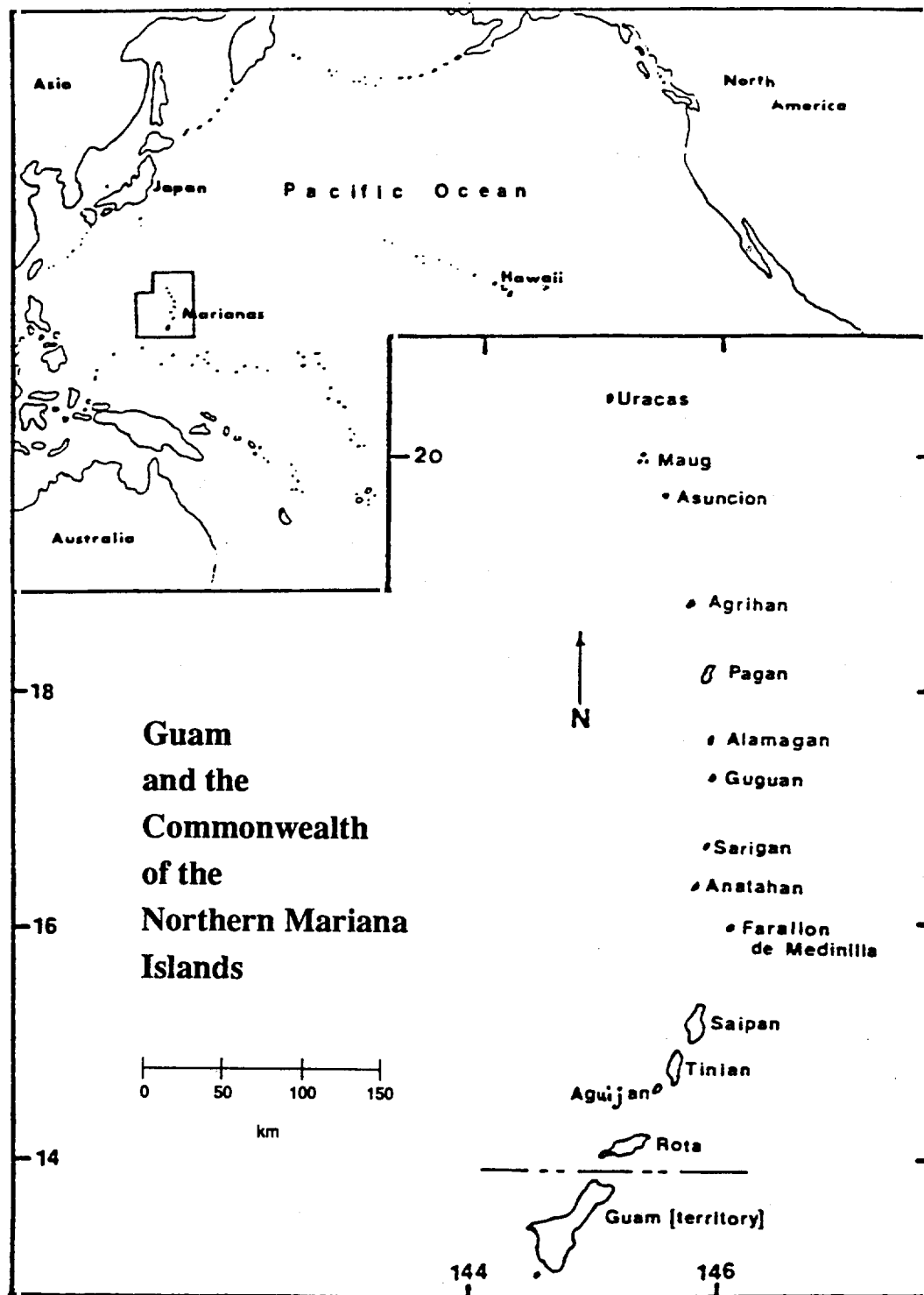


Figure 1. Map of the Mariana Islands.

species on other Mariana Islands are not federally protected at present. Critical habitat has not been designated for either fruit bat.

B. Location

Located in the western Pacific, the Mariana Islands comprise 15 islands extending over 800 km in a north-south arc (Figure 1). Guam 13° 28'N, 144° 45'E, the largest and southernmost island in the chain, has a land area of 540 km². Northern Guam is characterized by a large uplifted limestone plateau fringed near the ocean by tall cliffs and steep hillsides that fall to narrow terraces or directly into the sea. The southern portion of the island is volcanic in origin, although some hills are capped with limestone. A tall ridge bisected with deeply eroded ravines runs along the southwestern coast. Elevations on the island range from sea level to 180 m in the north and 400 m in the south.

Guam's climate is tropical and temperatures remain warm and relatively consistent during the year, ranging from 22 degrees to 33 degrees centigrade. Annual rainfall varies considerably among years but averages 2180 mm, most of which falls from July to November. A dry season occurs between January and May when rains diminish to 0 to 150 mm per month. The island's vegetation has been described in detail by Fosberg (1960) and Stone (1970).

Guam is an unincorporated territory of the United States. The island's human population has grown tremendously since the turn of the century, increasing from 9,700 residents in 1901 to 22,000 in 1940 to 106,000 in 1980 (U.S. Department of Commerce 1982). Chamorros, the indigenous people, make up about 42 percent of the present population.

C. Species Descriptions

The Mariana fruit bat is a medium-sized member of the genus Pteropus. Ranges for body measurements of adults and subadults are: head-rump length, 195 to 250 mm; forearm length, 134 to 154 mm; wingspread, 860 to 1065 mm; and body weight, 330 to 577 gr (Perez 1972, Wiles 1985). Males are slightly larger than females. The abdomen and wings are dark brown to black with individual gray hairs intermixed throughout the fur (Andersen 1912). The mantle and sides of the neck are bright gold on most animals but in some individuals, this region may be pale gold or pale brown. The color of the head varies from brown to dark brown.

The little Mariana fruit bat is much smaller than the Mariana fruit bat and adults have body measurements of: head-body length, 140 to 151 mm; forearm length, 94 to 95 mm; wingspan, 650 to 709 mm; and body weight, 152 gr (Tate 1934, Perez 1972, K. Koopman 1985). The abdomen and wings are brown to dark brown but with few whitish hairs present (Tate 1934). The mantle and sides of the neck vary from brown to pale gold. The top of the head is grayish to yellowish brown while the throat and chin are dark brown.

D. Past and Present Status

Both species of fruit bat probably once occurred throughout Guam in forested areas that formerly occupied most of the island. Estimates of historical populations are not available. In 1920, Crampton (1921) reported bats to be "not an uncommon" sight as they flew over forest during the daytime.

During a 2-month visit to Guam in 1931, Coultas (1931) noted that fruit bats were uncommon on the island and believed that the introduction of firearms had lead to their decline. He reported

that bats were most abundant in northern Guam. In 1945, Baker (1948) found the Mariana fruit bat in the northern half of Guam to be uncommon and confined primarily to forested cliff lines. He failed to locate a single colony during almost a year of field work. Reports obtained by Baker from residents indicated that fruit bats were also scarce in southern Guam. Woodside (1958) estimated that a maximum of 3,000 bats remained on the island in 1958. Monthly counts of the Mariana fruit bat on military lands in the 1960's indicated that the island's bat population was dropping, especially on Naval Magazine where density declined from 1.4 to 0.1 bats seen per hectare (Perez 1972) between 1962 and 1968. Fruit bat numbers decreased even further during the 1970's. Kami et al. (1976) estimated that fewer than 1,000 Mariana fruit bats remained in 1972 and less than 100 bats from 1974 to 1977. Wheeler and Aguon (1978) conducted an intensive island-wide survey in 1978 and concluded that fewer than 50 fruit bats survived on Guam.

Between 1980 and 1982, the island's population of the Mariana fruit bat increased up to an estimated total of 850 to 1,000 animals, probably the result of immigration of bats from Rota, which lies 60 km north of Guam, and natural recruitment (Wiles, in prep.). An intensive survey of fruit bats by the Guam Division of Aquatic and Wildlife Resources (DAWR) staff made from February to April 1984 produced an estimate of only 425 to 500 animals (Wiles, in prep.). Most of the bats recorded during the survey were in a single colony found on Andersen Air Force Base (Andersen AFB) in northern Guam. Fruit bats probably occur in very low numbers in forested areas elsewhere on the island (Figure 2).

The little Mariana fruit bat has always been considered rare by hunters, elderly residents, and scientific collectors (Baker 1948, Perez 1972). Few specimens have ever been collected, the last being a female killed by hunters in June 1968 at Tarague Point

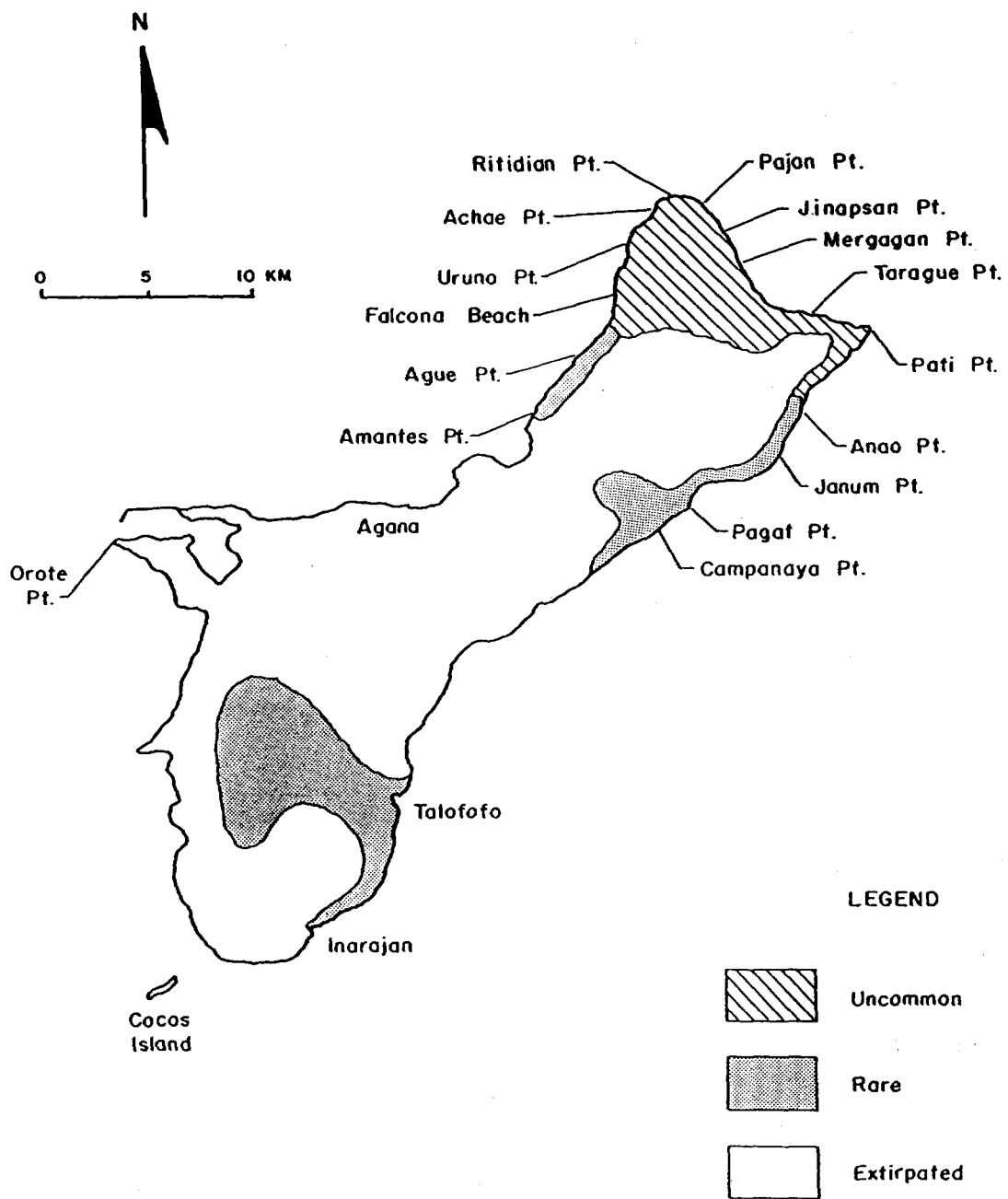


Figure 2. Distribution of Mariana fruit bats on Guam based on sightings of bats made from 1983 to 1985.

(Perez 1972). This was the only individual of little Mariana fruit bat present among more than 100 fruit bats shot and examined in the 1960's. Aside from one possible sighting by M. Wheeler (1979a) at Ritidian Point in June 1979, no other sightings of this species have been made since 1968 despite intensive field work by Wheeler in 1978 and 1979 and Wiles since 1981 (Wiles, inprep.). Thus, it appears that the little Mariana fruit bat may now be extinct.

E. Habitat Requirements

Habitat Use. Nine vegetation types have been described for Guam (Fosberg 1960, Stone 1970) with at least four of these probably used regularly by Mariana fruit bats. In northern Guam, where these animals are most common, bats forage and roost mainly in native limestone forest. Coconut groves and strand vegetation are other plant communities used occasionally for feeding and roosting. In southern Guam, a few fruit bats still inhabit ravine forest. Farms, savannas and mangroves are habitats that receive little or no use at present but may have been used commonly in the past when bats were more abundant and widespread on the island.

Wiles (1981a, 1982a, 1983a) described the characteristics of six roosts used by colonies of Mariana fruit bats. These sites occurred in limestone forest and were found along or within 100 m of the large 80 to 180 m tall cliffline that fringes northern Guam. Bats preferred to roost in mature fig trees (Ficus sp.) at five colonies and in chopak (Mammea odorata) at a sixth location. Other roosting trees included gago (Casuarina equisetifolia), pengua (Macaranga thompsonii), panao (Guettarda speciosa), and fagot (Neisosperma oppositifolia). Gago and fig trees are commonly used for roosting by solitary animals and small groups of 2 to 15 bats (Wheeler and Aguon 1978).

Only a single reference exists on the habitat used by little Mariana fruit bats. The animal killed by hunters in 1968 was taken below Tarague Point (Perez 1972) in an area of mature limestone forest.

Food Habits. The fruit bat feeds on a wide variety of plant material but is primarily frugivorous (Marshall 1983, 1985). Wiles (1983b) gathered information on the foods of Mariana fruit bats by direct observations, finding food remains (discarded fruit, chewed pellets of fruit pulp) of bats feeding, examining feces, interviewing island residents, and reviewing published accounts (Safford 1905, 1910, Linsley 1934, Stone 1970, Perez 1972, Wheeler 1979a). Twenty-two species of plants are known to be used as food sources by fruit bats in the Marianas. These include fruit of 17 species, flowers of 7 species and the leaf of 1 species. It appears that favored foods include the fruits of breadfruit (Artocarpus mariannensis and A. altilis), papaya (Carica papaya), fadang (Cycas circinalis), figs, kafu (Pandanus tectorius) and talisai (Terminalia catappa) and the flowers of kapok (Ceiba pentandra), coconut (Cocos nucifera), and gaogao (Erythrina variegata). The stems of leaves and tips of small twigs on breadfruit are also often eaten. Fruit bats have also been observed to feed on fagot and da'ok (Calophyllum inophyllum) on other islands. Both of these plants are found on Guam.

Activity Patterns and Movements. Since 1980, most of Guam's population of Mariana fruit bats have resided in one or several colonies in northern Guam. Animals in colonies sleep during much of the day but they perform many other activities as well. These include grooming, breeding, scent rubbing, marking, flying, climbing to other roost spots, and defending roosting territories (harem males only) (Wiles, 1985). Bats gradually depart colonies for several hours after sunset to forage. Perez (1972) observed that bats did not return to a colony on Orote Point until 8:00 a.m. (about 2 hours after dawn), however, at roosts at Jinapsin

Point and Pati Point from 1981 to 1985, Wiles (1985) found that almost all animals arrived before dawn. Wheeler and Aguon (1978) reported that solitary bats tended to be more mobile during the early morning hours. They observed flying bats most frequently from 5:00 a.m. to 9:00 a.m.

Little is known about the nightly movements of Mariana fruit bats. Occasional sightings of bats at night indicate that animals in northern Guam may disperse throughout the forested areas of Andersen AFB and Naval Communications Area Master Station (NavCAMS) to feed. When colonies are located on Pati Point, bats may travel as far as 10 to 12 km to reach feeding sites on the island's northwest coast. Guam's bat colonies roosted at 13 locations in northern Guam from 1981 to 1985 (Wiles, 1985). When undisturbed, Mariana fruit bats may roost at a single site for many consecutive months. However, illegal hunting at colonies often result in disturbances serious enough to cause bats to abandon their roosts and move to new sites. Since 1981, at least six changes in roost locations were directly related to disturbances caused by poaching. Colonies moved 0.6 km to 9.5 km (mean=2.9 km) to establish new roosts. Fidelity to former roosts appears to be low. Aside from a few favored locations, fruit bats generally do not return to sites used previously.

The frequency and role of colony-sized movements between islands in the southern Marianas in the past when Mariana fruit bats were once abundant can only be speculated upon. Residents report that migrations of bats between islands often occurred in the past; however, these reports have never been verified (Perez 1972). Two flights of this type from Rota to Guam apparently occurred in 1980 and 1981 (Wiles, in prep.). These flights offer the most reasonable explanation for the appearance of a bat colony at Pati Point in 1980 and the subsequent sudden increase in the colony's size in 1981.

Further evidence of a colony-sized movement to Guam in 1981 was obtained from a fruit bat hunter interviewed on Rota in 1981. He reported that after killing about 60 bats with shotguns at a roost in Rota, he and three partners watched the remainder of the colony, about 150 to 250 bats, fly south over the ocean toward Guam. The reported date of this incident coincided closely with the date of the second increase in bats at Pati Point. Despite frequent hunting at colonies on both islands after 1981 (Wiles, 1985, T.O. Lemke, 1985), no other flights between Rota and Guam are believed to have occurred. Hunting after 1981 resulted instead in the relocation of colonies to new roosting sites on the same island.

In July 1985, a small colony of 35 to 50 fruit bats was observed on Aguijan (D.T. Aldan, 1985), which previously held a small population estimated at less than 10 animals (Lemke 1984). This new colony probably arrived from Rota, which lies approximately 75 km to the south, rather than from nearby Tinian or Saipan, each of which possesses probably less than 25 bats (Lemke 1984). Because of the likelihood that Mariana fruit bats occasionally fly between islands in the southern Marianas, bats on these islands apparently belong to one contiguous population.

Social Organization and Reproduction. Recent studies (Wiles 1982b, 1983b, 1985) have provided much of the information known about the social organization and breeding biology of Mariana fruit bats. Within larger colonies of 60 to 800 animals, bats tend to segregate sexually and roost in harems, predominantly male bachelor groups, and singly (males only) on the periphery of the colony. Throughout the year, about 69 to 80 percent of all individuals roost in harems consisting of a single male and 2 to 15 females. Harem males maintain exclusive breeding rights with these females and only rarely tolerate the presence of another male. Females appear to be loosely bound to a particular harem. The number of females present in a harem may vary considerably

over a span of several days; even during periods as brief as two to three hours several females may arrive or depart from a harem. Colonies may also contain one or two groups of bachelor males that roost in nearby trees. These groups may number from 10 to 120 animals. Sexual segregation within bachelor groups is often not complete and up to 20 percent of the individuals present may be females. The remaining 3 to 8 percent of the bats in a colony consists primarily of solitary males found around the periphery of the roost.

Bachelor fruit bats have been observed occasionally to form separate smaller colonies with 10 to 125 animals. Among these colonies, a few females have been observed to roost temporarily in small harems with three to four members for several weeks.

From 1981 to 1984, about 5 to 10 percent of Guam's population of Mariana fruit bats roosted alone or in small groups of 2 to 12 animals during the day. In 1978, when the island's population numbered less than 50 animals, Wheeler and Aguon (1978) reported that most bats were solitary during the day.

At the Pati Point colony, Wiles (1982b, 1985) found an overall adult sex ratio of 37.5 males to 100 females in 1982 (n=700) and 72.7 males to 100 females in 1984 (n=475). Perez (1972, 1985) reported an adult sex ratio of 80 males to 100 females from a small sample of 18 animals shot while foraging in the early evening in 1968.

Mating and the presence of nursing young among Mariana fruit bats has been observed throughout the year on Guam (Perez 1972, Wiles 1983b, 1985). There does not appear to be a seasonal peak in the birth of young. During 17 of 18 monthly observations at colonies in which 50 to 100 females were identified from July 1982 to May 1985, 9.0 to 22.6 percent of these animals possessed small or medium-sized young. In the July 1982 sample, 32.7 percent of the

females observed carried young of these sizes. Of 262 females observed during this 3-year period, each bat had just 1 young at a time.

The length of pregnancy and age of sexual maturity in Mariana fruit bats is not known. Other species of fruit bats have an estimated gestation period of 4 1/2 to 6 months (Andersen 1912, Baker and Baker 1936, Gopalakrishna 1969). Wheeler and Aguon (1978) stated that Mariana fruit bats reached sexual maturity at 3 years of age, but this does not correspond with observations made in the field (Wiles, 1985). Field observation indicate that females are probably able to breed at about 6 to 18 months of age.

The only information available on breeding in the little Mariana fruit bat was gathered from a single female shot by hunters on June 5, 1968 (Perez 1972, 1985). This animal was with a juvenile that was able to fly away.

F. Reasons for Decline

Little is known about the reasons of decline for the little Mariana fruit bat however, presumably it and Mariana fruit bat have shared similar threats to their survival.

Overhunting/Poaching. Fruit bats have never been considered agricultural pests on Guam; rather, they are taken solely for human consumption. Overhunting has been and continues to be the most important cause in the decline of the Mariana fruit bat. Guam's population of these bats was probably reduced greatly during the early 1900's, when extensive hunting took place (Coultas 1931, Baker 1948). An expanding human population on Guam at that time probably fueled the demand for bats while an increased use of firearms may have made hunting more successful. Hunting of fruit bats has occurred for a long time, but it was outlawed in 1966. Although difficult to quantify, illegal hunting

of fruit bats has continued since 1966 when bats were first granted partial legal protection. From 1981 to 1984, eight cases of hunting at colonies and seven cases of night hunting along flyways or at feeding sites are known. More unrecorded incidents undoubtedly occurred. Colony hunting is the most destructive form of fruit bat hunting as animals in colonies typically roost close together in large numbers, and thus the bats are highly vulnerable to shotgun fire. Hunters report that 50 or more fruit bats can be easily killed in a single successful raid on a roost. In the past when fruit bats were abundant on Guam, the hunting of solitary animals at night at flyways or fruiting trees was productive and widely practiced. However, with fewer bats in recent years, this form of hunting has become more opportunistic and now generally occurs when lone bats approach a farm or are taken incidentally by people searching for wild betel nuts and peppers, or hunting for coconut crabs, sambar deer (Cervus unicolor) or wild pigs (Sus scrofa).

The prohibition of legal harvest of fruit bats on Guam has stimulated an import trade of closely related species of fruit bats to satisfy the culinary demands of local residents in the face of the scarcity of resident fruit bats on Guam. Large numbers of fruit bats have been imported from other Pacific Islands in recent years (Wiles and Payne, in press). From 1975 to 1984, approximately 8,000 to 24,000 fruit bats were shipped annually to the island for human consumption. Until 1982, most bats came from the Caroline and Mariana Islands, but since then, the other islands such as Western Samoa, American Samoa, Tonga, and Papua New Guinea are not major suppliers of fruit bats. This legal market may possibly be infiltrated with bats taken illegally on Guam.

Habitat destruction. Forest destruction has probably been a minor factor in the decline of fruit bats on Guam. Large stands of native forest have been cleared for agriculture and housing in

the central and north-central portions of the island. Sizable tracts of forest were also destroyed during the invasion and bombardment of Guam in World War II and by subsequent construction activities on newly established American military bases. Areas particularly affected were Andersen AFB, NavCAMS, and Naval Magazine (Baker 1946). However, fruit bats were already considered uncommon by 1931 (Coultas 1931). Sizable tracts of forest remained after the war and are still present today, yet few bats inhabit these forest lands. Food resources and potential roosting sites seem to be adequately available and not limiting the population of Mariana fruit bat (Wiles, 1985).

Exotic plants, plant diseases, and insects are also altering native forests. Insects have damaged fig trees. Chromalolaena odorata, a rapidly-spreading, densely-growing, exotic weed, is invading forest openings and inhibiting regeneration of native trees. Other potentially serious exotic pest species include Mikania scandens and cadena de amor (Antigonon leptopus), both are climbing vines that overgrow native vegetation.

Predation. Bats have evolved on Guam without the threat of major predators and probably have minimal defenses against them. The impact of predation by brown tree snakes (Boiga irregularis) on fruit bats is unknown but potentially serious. Snakes first arrived on the island shortly after World War II. They are a major nocturnal predator of birds and small mammals on Guam and are thought to be responsible for the nearly total disappearance of the island's forest-dwelling avifauna (Savidge 1986). Initially snakes were confined to central and southern Guam, but the population slowly spread northward and reached the extreme northern portion of the island by the early 1980's.

The brown tree snake appears capable of preying on at least young bats. Stomach contents of large snakes routinely contain adult roof rats (Rattus rattus) (Savidge 1986) which are similar in size

to juvenile Mariana fruit bats. Only one case of snake predation on bats has been reported. A local resident related killing a 2.5 m-long snake which contained three young fruit bats in its stomach during 1982 at a site 0.8 km south of Ritidian Point (Wiles, 1983b). Other evidence, although circumstantial, suggests that snakes may be preying on young Mariana fruit bats at roosts. The proportion of large juvenile bats in the main colony rose dramatically from 5.0 (n=60) to 46.6 percent (n=88) of all young present when roosting sites changed from Pati Point to Jinapsan Point in December 1982 (Wiles, in prep.). From September 1984 to May 1985, when the colony was again residing at Pati Point, no (0 percent) large juveniles were noted among 100 young observed (Wiles, 1985). Sightings of snakes and their molted skins, together with high disappearance rates of birds, indicate that snakes inhabited Pati Point several years longer and were more common there than at Jinapsan Point (Wiles, in prep.). Young bats of this age are particularly vulnerable to predation because they are not yet able to fly and are too large to be carried by their mother during nighttime foraging. Thus, they are left overnight at the roosting site where they may be susceptible to nocturnal predators. Several snakes have been captured or seen within 100 m of the colony at Pati Point.

The brown tree snake may be more directly involved in the post-World War II decline of fruit bats in southern and central Guam than originally thought. The snake has occurred there sympatrically with fruit bats for the past 30 years. However, because of the recent invasion of snakes into the extreme northern end of the island, they do not share the blame for decreases in the number of fruit bats in that region prior to 1980.

Predation on fruit bats by other animals has not been recorded. Black drongos (Dicrurus macrocercus), an introduced bird that is highly territorial, occasionally chase and peck at solitary flying

bats (Perez 1972, Wheeler and Aguon 1978). However, this behavior has not caused any known serious injuries or mortalities to bats.

Typhoons. Typhoons are a rare but potentially serious threat to Guam's small number of remaining Mariana fruit bats. Strong typhoons with sustained winds of more than 250 kph (155 mph) strike the island about once every 10 to 15 years. Although there is no direct evidence that storms have ever greatly reduced fruit bat numbers on Guam in the past (probably due to a lack of serious observations), severe typhoons have been implicated in precipitous declines of fruit bats on several islands in the western Indian Ocean (Cheke and Dahl 1981). Gale-force winds on Guam are capable of denuding large forested areas of foliage and fruit (Kami et al. 1976) and residents have reported finding dead bats under roosting trees after strong storms. Animals not killed directly by winds could face a period of up to several months of low food supplies. In the past, when fruit bats were more common throughout the island, a severe typhoon would be unlikely to have a long-lasting adverse impact on the entire bat population. However, under present conditions, with most animals concentrated in a single colony, a typhoon directly striking northern Guam could produce disastrous results.

G. Conservation Measures Already Taken

Status, Distribution, and Life History Studies. Perez (1972) was the first to describe the population status and general biology of Mariana fruit bats on Guam. The first extensive survey of fruit bats was made in 1978 by Wheeler and Aguon (1978). Additional information on biology, behavior, and management recommendations were presented by Wheeler (1979a, 1979b, 1980).

Recent studies (Wiles 1981a, 1981b, 1982a, 1982b, 1983a, 1983b, 1984a, 1984b, 1985) have investigated the abundance, daytime roosting behavior, breeding biology, diet, and illegal hunting of

the Mariana fruit bat. A second island-wide survey for bats was conducted in 1984 (Wiles, in prep.).

Protection and Law Enforcement Measures. Fruit bats received limited protection in 1966 when the Government of Guam ended year-round hunting of bats and established a 10-week hunting season for them. During succeeding years, the lengths of seasons and bat limits became more restrictive as bat numbers continued to decrease. Finally, all hunting was prohibited in 1973 (Wheeler 1979b). Additional protection was given to fruit bats in 1981 and 1984 when both species were placed on the Guam and United States Endangered Species Lists, respectively.

Conservation laws on Guam are enforced by conservation officers of the Guam Division of Aquatic and Wildlife Resources (Guam DAWR) of the Government of Guam, by a single Federal National Marine Fisheries Service/Fish and Wildlife Service agent on Guam, and with the assistance of security forces on military bases. From the mid-1960's to the late 1970's, the Guam DAWR employed three to five conservation officers. This number increased to eight officers in 1981 when additional funding became available through the Coastal Zone Management program of the U.S. Department of Commerce and the Government of Guam. Bat poachers are difficult to apprehend because of rough terrain and thick, remote forest. During the past 5 years, only two people have been arrested and convicted for illegally taking bats. Neither of these arrests were made for poaching at colonies.

Protected Areas. The Government of Guam has established four conservation reserves that occupy 1,700 hectares of land for the protection of wildlife and native habitats. Two reserves, Anao (Figure 3 essential habitat No. 13) and Y-piga, are located in northern Guam while two others, Cotal and Bolanos (Figure 4, essential habitat unit No. 5), occur in the southern half of the

island. Although three of the areas contain forest suitable for fruit bats, these reserves have been of minimal value to fruit bat conservation efforts because of the lack of enforcement of conservation laws within them.

Cocos Island, located 2.5 km southwest of Guam (Figure 4), is 39 ha in size with 12 ha included in Guam's Territorial Seashore Park. The island is free of brown tree snakes and, therefore, is sometimes suggested as a site for a wildlife reserve. However, the island is considered unsuitable for harboring a population of Mariana fruit bats because of the significant tourist development that has already occurred, the possible lack of sufficient food to support bats on a year-round basis, the vulnerability of the island to typhoons, and the difficulty in preventing violations of conservation laws on the island.

In 1973, the Air Force set aside a 281 hectare area of cliffline habitat, designated as the Pati Point Natural Area, on Andersen AFB for nature conservation.

Military bases have been important in prolonging the existence of fruit bats on Guam since World War II. By limiting access by civilians and clearing few additional stands of native forest in the past 30 years, military reservations have functioned as partial refuges for fruit bats where habitat is maintained and illegal hunting is somewhat inhibited. Although bats have survived longer on these lands than in non-military area, trespassing poachers have gradually depleted the bats on these bases as well. At present, Andersen AFB, which occupies about 6,250 hectare, is the only area on Guam with a fruit bat population larger than just a few isolated individuals.

The U.S. Navy has recently established two small ecological reserve areas at Haputo (Area 6, Figure 3 - see Appendix) and Orote Peninsula (Figure 4 - see Appendix). These areas have some

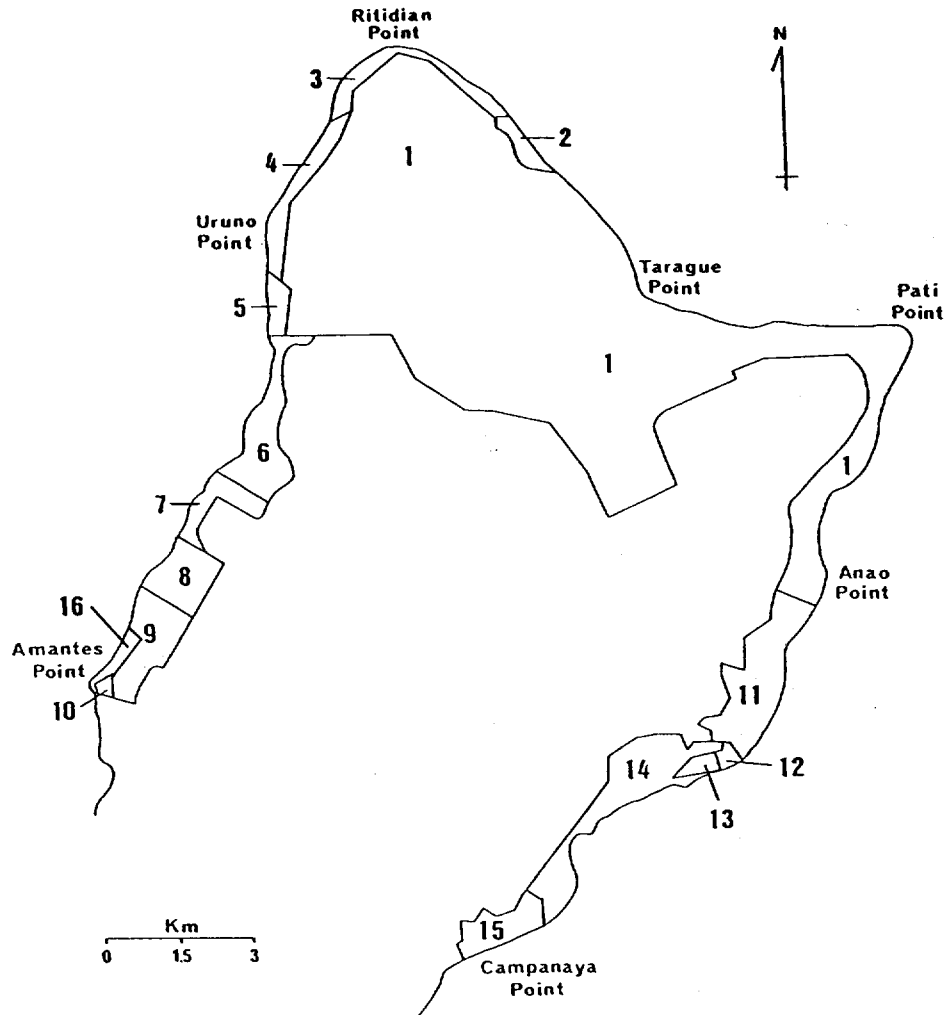


Figure 3. Essential habitat of fruit bats in northern Guam. Key to designated areas: Andersen Air Force Base (1); private property from Mergagan to Pajon Point (2); Naval Facility (3); private property from Achae Point to Falcona Beach (4); territorial property at Falcona Beach (5); Naval Communication Area Master Station (6); Federal property from Ague Point to Amantes Point and administered by Federal Aviation Authority (7); Navy (8); and Air Force (9); Puntan Dos Amantes Park (10); Anao Conservation Reserve (11); private property at Janum Point (12); Lot Numbers 7102 and 7103 (13); Lot Number 7147 (14); Lot Number A (15); and private property at Dos Amantes Point (16).

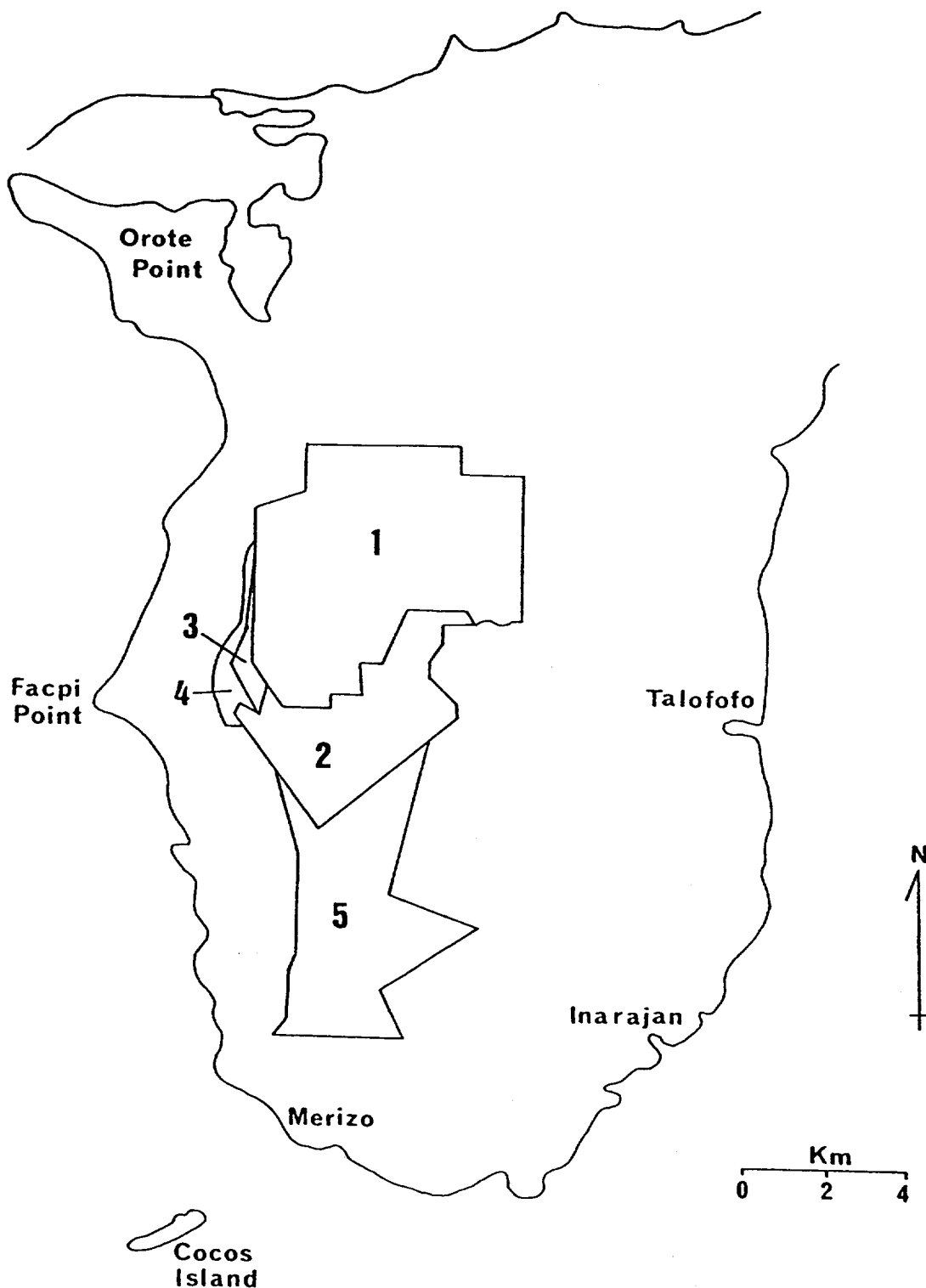


Figure 4. Essential habitat of fruit bats in southern Guam. Key to designated areas: Naval Magazine (1); Naval Reservation (Fena Valley Watershed) (2); private property at Sinaje, Agat (3); territorial property in Agat found above the 800-foot contour on Tracts DA and EA (4); and the Bolanos Conservation Reserve (5).

promise as secure habitat for fruit bats.

Public Education. The Guam DAWR operated a public information program from December 1979 to August 1983 with funding provided by the Coastal Zone Management Program of the U.S. Department of Commerce. The program was designed to disseminate information about Guam's wildlife and foster an appreciation for the island's natural resources. A large portion of the program was centered on endangered species, including fruit bats, and the prevention of poaching. The program was staffed by a full-time public information officer and featured public displays, talks, endangered species posters illustrating endangered species and their habitat, newspaper articles, radio programs, television programs, public service announcements, and a puppet show. This program has been discontinued due to a termination of funds.

II. RECOVERY

A. Objective

The primary objective of the Guam fruit bat recovery plan is to restore the island's population of Mariana fruit bats to threatened status and to determine the status of little Mariana fruit bats. The population of Mariana fruit bats should be increased to at least 2,500 animals with a minimum of two permanent colonies in northern Guam and one permanent colony in southern Guam with each colony supporting at least 400 bats.

None of the problems facing Mariana fruit bats are easily solved and it is clear that major commitments of time, money, and personnel will be needed to remedy them. Responsibility for the protection and management of fruit bats does not lie with any single group but belongs with all government agencies involved. It is important that territorial, military, and Federal agencies work closely together in solving these problems. Without full cooperation from each of these organizations, a recovery of Guam's fruit bat population will be slow in coming. Cooperation from the government of the Commonwealth of the Northern Mariana Islands should be sought; their own bat conservation program has much to benefit from restoration of fruit bats on Guam.

B. Narrative

1. Minimize mortality.

Sources of mortality must be minimized to prevent further reductions in the present population and allow for expansion of new populations of Mariana fruit bats.

11. Control illegal hunting of fruit bats.

It will be necessary for conservation officers, military security police, and federal wildlife law enforcement agents to work together in a combined effort to eliminate illegal fruit bat hunting.

111. Law enforcement efforts by the Guam Aquatic and Wildlife Resources (DAWR).

The Guam DAWR, with its staff of conservation officers, is the primary agency entrusted with enforcing the island's conservation laws. Patrols by conservation officers for bat poaching should become a regular activity of high priority.

1111. Regularly patrol public and private lands for bat poaching.

Patrols by specially trained officers should be made at sufficient frequencies to effectively deter illegal hunting. Patrols for bat hunting should be concentrated on Andersen AFB where most of the island's population of Mariana fruit bats reside. Patrols should be centered near known bat roosts and the Conventional Weapons Supply Area and Northwest Field, which are two favored foraging areas of bats. Patrol efforts should be expanded in the future, if needed. Patrols should also be made on Navy lands including NavCAMS, Naval Facility and Naval Magazine. Also, an assessment of the need for full-time guards at known colonies should be done in cooperation with the military security forces. Permission should be obtained from landowners to patrol private property near Jinapsan Point and Uruno Beach in northern Guam and several large pieces of property adjacent to Naval Magazine in southern Guam. Patrols should be made on Territory of Guam lands near Andersen AFB and on the Bolanos Conservation Reserve.

1112. Continue to monitor illegal hunting activities presently occurring.

Evidence found at poaching sites can indicate the approximate number of bats killed, the number of people involved, their hunting methods and their access routes used and can be collected for use in court cases. A record of all poaching incidents should be kept.

1113. Interview former hunters to learn more about hunting techniques.

Former hunters can provide information on hunting techniques that can possibly be used to prevent future poaching incidents or linking evidence with suspects.

1114. Determine the effects of the fruit bat import trade on Guam's fruit bat populations and devise appropriate regulatory strategies.

The full effects of the fruit bat import trade on bat population on Guam and other islands needs to be evaluated. The frequency of illegally killed Mariana fruit bats being sold among legally imported bats should be determined. In its present form, the trade is a cause for concern because of the severe declines in bat numbers that it has caused on some nearby islands that export bats (Wheeler 1980; Falanruw, in prep., T.O. Lemke 1985).

11141. Determine the identity and origin of imported fruit bats through standard monitoring of imported bats or the use of electrophoretic tests and comparison with museum specimens.

Law enforcement officials need the capability of determining the identity and origin of dead fruit bats so illegally killed Mariana fruit bats can be distinguished from legally imported bats. Electrophoresis is a method that allows closely related species of animals to be differentiated through comparison of body tissue proteins. Initiation of this activity and the comparison of animals with museum specimens should be performed

cooperatively among Guam DAWR and Federal wildlife officials and fruit bat taxonomists.

11142. Establish appropriate regulations on the fruit bat import trade into Guam to prevent confusion with protected Guam bats.

Current regulations controlling this import trade are inadequate and there is risk that illegally-taken local Mariana fruit bats may be trafficked among imported animals. A stricter, revised permit system and set of regulations are needed for importers and retailers of fruit bats. Tighter controls should be designed to prevent abuses but not prohibit the legal trade in bats.

112. U.S. Air Force and Navy law enforcement efforts.

Assistance by Air Force and Navy security Forces is essential in controlling illegal hunting of fruit bats on Guam. In a number of cases in the past, military security police have captured and turned over poachers or reported violations in the act to conservation officers. Several of these instances have involved fruit bat hunting. Involvement of military security forces on military lands is essential.

1121. Increase awareness of military security forces about illegal hunting of fruit bats.

A program should be initiated to inform all military security police on the severity of the problem of illegal hunting of wildlife, including fruit bats, on Guam. Because of the high turnover rate among security personnel, training sessions, administered by Guam DAWR enforcement staff, should be held frequently during the year.

1122. Have military security forces contribute to patrol efforts for illegal hunters.

Military security personnel should actively patrol for illegal hunting during their routine patrols, report illegal activities as they occur to conservation officers, provide backup assistance to conservation officers when needed, and help with investigations of poaching cases.

113. Federal wildlife law enforcement efforts.

The U.S. Fish and Wildlife Service and the National Marine Fisheries Service have maintained a special agent on Guam since 1981. This officer should be encouraged to assist in investigations of fruit bat poaching, to provide special training courses for conservation officers and military security forces, and to make special resources, such as laboratory and forensic ballistics tests, available during investigations. Funding for rewards and reward posters may be available through this agent's office.

114. Develop a multi-agency anti-poaching strategy which defines roles and responsibilities of all involved agencies.

All Federal and territorial agencies with a role to play in protecting fruit bat colonies need to coordinate their efforts and develop an effective approach to the prevention of poaching.

1141. Develop and implement plan.

An overall plan defining roles and responsibilities in preventing poaching of fruit bats needs to be developed and implemented.

1142. Meet periodically to review effectiveness and refine plans.

Regular meetings between all involved agencies are needed to review effectiveness of anti-poaching programs. Such meetings will allow maximum effectiveness of programs.

115. Guam Police Department law enforcement efforts.

Officers of the Guam Police Department should be encouraged to be alert for and report wildlife violations. This agency's crime lab should provide assistance to conservation officers during poaching investigations. A class period of several hours at the training academy for new police officers should be devoted to education about existing wildlife laws.

116. Encourage local and Federal judicial authorities to prosecute fruit bat poachers aggressively.

Local and Federal judicial authorities should be made aware of the seriousness of illegal hunting of Mariana

fruit bats. Aggressive prosecution of the illegal take, sale, and military trespass laws is needed to deter future poaching attempts.

12. Prevent predation by brown tree snakes.

Predation by brown tree snakes is potentially a second important cause of fruit bat mortality. Present data appear to indicate that juvenile bats are most seriously affected by predation.

121. Determine the extent of predation on fruit bats by snakes.

The impact of brown tree snakes on fruit bats deserves immediate study. Current levels of predation on bats, especially juveniles, may be higher than realized. The age classes of bats that are most susceptible to predation by snakes must be investigated. The extent of predation occurring at colonies and during foraging at night must be determined.

122. Investigate and implement methods of snake control.

There is an urgent need for a study to be conducted by qualified researchers to find a safe but effective method of controlling snakes that can be applied to remote, complex habitats without endangering non-target animals. Control of snakes in and around fruit bat colonies should be an initial priority, if needed.

1221. Investigate the biology and ecology of snakes.

Additional research on the biology and ecology of brown tree snakes will provide information useful in testing and implementing methods of controlling snakes. Studies should be made on the demographics, habitat use, and activity patterns of snake populations.

1222. Develop and test trapping methods for snakes.

A trapping program for snakes may be a feasible method of control at colonies. However, a program of this type must be carefully set up because fruit bats become highly agitated and frightened at the odor of man. Bats normally abandon colony sites after poaching attempts. Traps placed at colonies should require little maintenance so that few

visits by people are required. Colonies may not be completely empty of bats at anytime during the night. Some individuals (such as large juveniles, lactating females, and harem males) may remain at the colony all night or be gone just a few hours. Observations to determine when the fewest number of bats are present should be made prior to the start of trapping. Visits to colonies to set traps should be made at the proper time of night and be as brief as possible. Trapping-related disturbances could result in the abandonment of a roost and force a colony to move to a new site where the bats could be more vulnerable to poaching and predation. Thus, the entire trapping process would have to be initiated again.

1223. Develop and test other control methods for snakes.

Control measures such as toxicants, attractants, and biological control should be developed and tested to avoid problems associated with trapping of snakes. This effort should be combined with similar efforts aimed at the conservation of Guam's native forest birds.

1224. Implement a program for controlling snakes in essential habitat of fruit bats.

After effective snake control measures have been developed, they should be applied to reduce snake numbers in larger areas of essential fruit bat habitat. Implementation of control methods will require close cooperation from the Guam DAWR, the U.S. military, and the U.S. Fish and Wildlife Service. Control programs should be monitored to document successes and failures and to provide a basis for modification of techniques to increase efficiency and economy.

1225. Prevent the expansion of the brown tree snake population to other islands within the range of the Mariana fruit bat.

Methods must be devised to prevent the introduction of the brown tree snake to the Northern Mariana Islands. Public information, strict screening of cargo from Guam, thorough control at cargo dispatch areas, and techniques to monitor for snakes in cargo and at receiving areas must be developed.

2. Determine ecological requirements of fruit bats.

Studies of ecological requirements of fruit bats will provide information useful in further identification and management of essential habitats, and bat colonies.

21. Determine habitat preferences.

The limestone forest in northern Guam, which presently holds the island's largest population of Mariana fruit bat is not homogeneous in composition. Habitat preferences within these limestone forest communities and other habitat types by fruit bats need further study.

211. Conduct additional field studies to determine geographical areas occupied.

Further information is needed on the locations of foraging and roosting areas. Radio tagging of bats, additional observations of bats at night, and continued searches for roosts will help provide this information.

212. Develop detailed descriptions of occupied habitats and map these areas.

The composition of vegetation in habitats occupied by bats should be described and these areas mapped. These studies will provide information useful in choosing locations for possible future reestablishment attempts of fruit bats, in detecting the invasion of undesirable introduced plants into essential habitats, and in reconstructing suitable plant communities for use by fruit bats in the future.

213. Determine the minimum area of suitable habitat needed to sustain a viable population of bats.

This information should be known in case of further shrinkage of essential habitat. An area of this type must contain suitable colony roosting sites and foods that are available year-round.

22. Determine food habits.

Additional information of food habits will be an integral part of assessing preferred habitats and geographical areas that may be used.

221. Continue to gather field data on use of foods.

Studies on the food habits of Mariana fruit bats that began in 1983 should be continued.

222. Determine the phenology of bat foods.

A study on the phenology of fruit and flowers eaten by bats will determine their availability to bats.

23. Determine movement patterns of fruit bats on Guam.

Knowledge of movements of bats is another important part in assessing preferred habitats and geographical areas used. Nocturnal movements and home range sizes of foraging bats should be studied through the use of radio telemetry. Changes in the locations of colony roosts should continue to be monitored by direct observations, radio telemetry, and tagging.

24. Determine factors for maximizing reproduction.

An understanding of reproductive rates of fruit bats is needed to determine potential rates of increase for the population and possible predation rates of brown tree snakes. This information will help determine subsequent management efforts that are needed to maximize reproductive success.

241. Gather and analyze information on the breeding biology of Mariana fruit bats.

Observations to determine the percent of adult females with young at colonies began in 1982 and should be continued. Information on juvenile growth rates, age of sexual maturity, and breeding rates should be obtained. This information can then be used to understand what normal, healthy reproductive rates should be.

242. Determine factors limiting reproductive success.

Any number of factors could be influencing the ultimate success of reproductive efforts, including food supply, disturbance at roost sites, etc. These factors need to be understood as to how they may currently be affecting reproduction.

243. Determine incidence and causes of infant mortality.

The rates, causes, and ages of occurrence of mortality of infant fruit bats should be examined.

3. Secure and protect essential forest ecosystems.

Protection is needed to maintain essential forest habitats for a long-term conservation program for fruit bats. Areas of essential

habitat were determined by fruit bat studies conducted from 1978 to the present and include limestone and ravine forests, coconut groves, and beach strand vegetation. Areas in northern Guam comprise a 43 km-long strip of forest around the island's northern coastline. They will be valuable as habitat for bats and as a source from which bats will be able to recolonize the remainder of the island in the future. Essential habitats in southern Guam presently hold few fruit bats, but must be preserved so that a larger population of bats can be reestablished in this portion of the island. Present land-use schemes should be allowed to continue in all areas; however, future forest clearing or other disturbances should not be permitted.

31. Preserve and manage existing essential forest habitats of fruit bats on federally-owned lands.

Most essential habitat for fruit bats occurs on federally-owned military reservations. Future plans for expansion of military facilities may threaten some of this habitat.

311. Andersen Air Force Base.

Protection should be given to all native forest and coconut groves that occur on Andersen AFB (Figure 3, unit 1). This is the largest parcel of essential habitat on the island. Part of this land (281 ha) has already been designated as the Pati Point Natural Area by the Air Force. The remaining pieces of essential habitat on the base should also receive protection from the Air Force, such as through the establishment of ecological reserve areas.

3111. Secure essential habitat.

The initial requirement for protecting and managing habitat involves providing some kind of long-term security which ensures that land uses of the area do not change to the detriment of the habitat available to fruit bats. Methods for the protection of this habitat will be developed with the cooperation of the landowner.

3112. Conduct baseline survey.

Baseline data on the status of the bat and its habitat are needed as a foundation for future planning and management.

3113. Develop management plan.

With the use of the baseline data for this area, and other relevant data on the fruit bat and its habitat, a site-specific habitat management plan should be developed. This will be tailored to the specific habitat conditions and other constraints surrounding the protection and enhancement of habitat in this particular area.

3114. Implement management plan.

Once a specific management plan is in place, steps should be taken to implement the needed tasks. All cooperators should contribute to seeing those tasks implemented. Because the Pati Point area on Andersen Air Force Base is in close proximity to the only known bat colony, a priority management action should be enforced to zone the area as a nonlegal sport hunting area. This will minimize accidental and intentional shooting incidents.

312. Naval Facility.

Protection should be given to all native forest and coconut groves on Naval Facility (Figure 3, unit No. 3). This narrow strip of land lies below the cliffline at Ritidian Point. Its forest should be protected to compliment efforts made on adjacent lands on Andersen AFB.

3121. See Narrative task 3111.

3122. See Narrative task 3112.

3123. See Narrative task 3113.

3124. See Narrative task 3114.

313. Naval Communications Area Master Station.

Protection should be given to all native forest and coconut groves that are within 1 km of the cliffline on NavCAMS (Figure 3, unit 6). Part of this land has been designated as an Ecological Reserve Area by the Navy. The Navy should expand its boundaries for this reserve to include all native forest and coconut groves within 1 km of the top of the cliffline. It should be made a permanent reserve.

3131. See Narrative task 3111.

3132. See Narrative task 3112.

3133. See Narrative task 3113.

3134. See Narrative task 3114.

314. Federally-owned lands from Ague Point to Amantes Point.

Protection should be given to all native forest and coconut groves that are within 1 km of the cliffline on federally-owned lands from the north side of Ague Point to Amantes Point (Figure 3, units 7, 8, & 9). Portions of this strip of land are administered and managed by the Federal Aviation Administration, the U.S. Navy, and the U.S. Air Force.

3141. See Narrative task 3111.

3142. See Narrative task 3112.

3143. See Narrative task 3113.

3144. See Narrative task 3114.

315. Naval Magazine and Naval Reservation (Fena Valley Watershed).

Protection should be given to all native forest on both of these areas (Figure 4, units 1 & 2). These Navy lands possess extensive stands of ravine forest and comprise the largest parcel of essential habitat in southern Guam. Forests on these properties contain potential roosting sites and a number of common food plants used by fruit bats. This land also serves as an important watershed for southern Guam.

3151. See Narrative task 3111.

3152. See Narrative task 3112.

3153. See Narrative task 3113.

3154. See Narrative task 3114.

32. Secure and protect essential forest habitats of fruit bats on privately-owned lands.

Several private landowners possess essential forest habitat for fruit bats. It is recommended that the following pieces of property be secured and protected.

321. Mergagan Point to Pajon Point area.

Some means of permanent habitat security should be obtained for private land between Mergagan Point and Pajon Point (Figure 3, unit 2). This shoreline property is surrounded by Andersen AFB and Naval Facility and is used by foraging fruit bats. Several colonies of Mariana fruit bats have roosted within 0.5 km of this property since 1983.

3211. See Narrative task 3111.

3212. See Narrative task 3112.

3213. See Narrative task 3113.

3214. See Narrative task 3114.

322. Achae Point to Falcona Beach area.

Some means of permanent habitat security should be obtained for private property between Achae Point and Falcona Beach (Figure 3, unit 4). This segment of essential fruit bat habitat occurs along the shoreline and is bordered by Andersen AFB, Naval Facility, and a small parcel of Territory of Guam land. This area contains foraging habitat and potential roosting sites along its cliffline.

3221. See Narrative task 3111.

3222. See Narrative task 3112.

3223. See Narrative task 3113.

3224. See Narrative task 3114.

323. Janum Point area.

Some means of permanent habitat security should be obtained for private property at Janum Point (Figure 3, unit 12). This small piece of privately-owned land is surrounded by property owned by the Territory of Guam that has been designated for conservation uses. This area contains foraging habitat and potential roosting sites for fruit bats.

3231. See Narrative task 3111.

3232. See Narrative task 3112.

3233. See Narrative task 3113.

3234. See Narrative task 3114.

324. Sinaje, Agat area.

Some means of permanent habitat security should be obtained for private property in Sinaje, Agat in southern Guam (Figure 4, unit 3). This small piece of privately-owned land is bordered on the east by Naval Magazine and Naval Reservation (Fena Valley Watershed) and on the west by territorial-owned property that has been designated for conservation uses. This area contains foraging habitat and potential roosting sites for fruit bats.

3241. See Narrative task 3111.

3242. See Narrative task 3112.

3243. See Narrative task 3113.

3244. See Narrative task 3114.

325. Amantes Point area.

This is a private property north of Amantes Point (Figure 3, unit 16). This segment of essential fruit bat habitat occurs along the shoreline and is bordered by U.S. Air Force and Territory of Guam lands. This area contains foraging habitat and potential roosting sites along its cliffline. Part of this land is currently threatened by a proposed development project.

3251. See Narrative task 3111.

3252. See Narrative task 3112.

3253. See Narrative task 3113.

3254. See Narrative task 3114.

33. Protect and manage essential habitat of fruit bats on lands owned by the Territory of Guam.

Several segments of essential fruit bat habitat are owned by the Territory of Guam. All of these lands are designated for conservation purposes (Guam Coastal Management Program 1984). Attempts to change the designation of this property should be denied.

331. Area from Anao Point to Campanaya Point.

Essential habitat should be maintained on territorially owned lands from the eastern boundary of Andersen AFB at Anao Point south to Campanaya Point. Five parcels of territorially owned land comprise this strip of cliffline essential forest habitat. These include the Anao Conservation Reserve (designated as Lot Number 7146, Figure 3, unit 11) and Lot Numbers 7102, 7103, 7147, and A (Figure 3, units 13, 14, & 15). The present habitats on these lands should be maintained or in the case of disturbed areas, allowed to revert to mature forest.

3311. See Narrative task 3111.

3312. See Narrative task 3112.

3313. See Narrative task 3113.

3314. See Narrative task 3114.

332. Falcona Beach area.

Essential habitat should be maintained on territorially owned land at Falcona Beach (Figure 3, unit 5). This property is bordered by Andersen AFB, Naval Communications Area Master Station, and private land. This strip of cliffline forest contains foraging habitat and potential roost sites for fruit bats.

3321. See Narrative task 3111.

3322. See Narrative task 3112.

3323. See Narrative task 3113.

3324. See Narrative task 3114.

333. Puntan Dos Amantes Park.

Essential habitat should be maintained on territorially owned land at the Puntan Dos Amantes Park (Figure 3, unit 10). This small park is located at Amantes Point and is the south-westernmost parcel of property in northern Guam to be included as essential habitat. This land is administered by the Guam Department of Parks and Recreation.

3331. See Narrative task 3111.

3332. See Narrative task 3112.

LITERATURE CITED

- Aldan, D.T. 1985. Personal communication to the U.S. Fish and Wildlife Service. Department of Natural Resources, Commonwealth of the Northern Mariana Islands, Saipan 96950.
- Andersen, K. 1912. Catalogue of the Chiroptera in the collection of the British Museum. Volume I: Megachiroptera. British Museum (Nat. Hist.), London.
- Baker, J.R., and Z. Baker. 1936. The seasons of a tropical rain forest (New Hebrides). Part 3. Fruit bats (Pteropidae). J. Linn. Soc., London 40:123-141.
- Baker, R.H. 1946. Some effects of the war on the wildlife of Micronesia. Trans. N. Am. Wildl. Conf. 11:205-213.
- Baker, R.H. 1948. Comments on conservation problems in Micronesia. In Coolidge, H.J. (ed.). Conservation in Micronesia. Pages 53-55. National Research Council, Washington, D.C.
- Baker, R.H. 1985. Personal communication to the U.S. Fish and Wildlife Service. 302 North Strickland St., Eagle Lake, Texas 77434.
- Cheke, A.S., and J.F. Dahl. 1981. The status of bats on western Indian Ocean islands, with special reference to Pteropus. Mammalia 45:205-238.
- Coultas, W.F. 1931. Whitney South Seas Expedition Journals, Vol. W. Journal and letters, Vol. II, of William F. Coultas, November 1930 to December 1931. Amer. Mus. Nat. Hist., New York.
- Crampton, H.E. 1921. A journey to the Mariana Islands - Guam and Saipan. J. Amer. Mus. Nat. Hist. 21:127-145.
- Falanruw, M.V.C. in prep. Taxonomy, biology and management of fruit bats of Yap, Pteropus mariannus yapensis and Pteropus mariannus ulthiensis.
- Falanruw, M.V.C. 1985. Personal communication to the U.S. Fish and Wildlife Service. The Yap Institute of Natural Science, Box 215, Yap, Western Caroline Islands 96943.
- Fosberg, F.R. 1960. The vegetation of Micronesia. Bull. Amer. Mus. Nat. Hist. 119:1-75.

- Gopalakrishna, A. 1969. Gestation period in some Indian bats. J. Bombay Nat. Hist. Soc. 66:317-322.
- Guam Coastal Management Program. 1984. Guam public land-use plan. Bureau of Planning, Agana, Guam 96910.
- Kami, H.T., N. Drahos, R.D. Strong, and R.J. Lujan. 1976. Study of the fruit bat. In Guam Aquatic and Wildlife Resources Division Annual Report, FY 1976. Pages 72-75. Dept. of Agriculture.
- Koopman, K. 1985. Personal communication to the U.S. Fish and Wildlife Service. American Museum of Natural History, Central Park West at 79th Street, New York, New York 77434.
- Kuroda, N. 1938. A list of Japanese mammals. L.M. Zool. Soc. Japan, Tokyo, Japan.
- Lemke, T.O. 1984. Marianas fruit bat surveys and inventories. In Pittman-Robertson Federal Aid in Wildlife Restoration Program, Annual Report, FY 1984. Pages 3-16. CNMI Division of Fish and Wildlife, Saipan.
- Lemke, T.O. 1985. Personal communication to the U.S. Fish and Wildlife Service. Department of Fish, Wildlife, and Parks, P.O. Box 595, Thompson Falls, Montana 59873.
- Linsley, L.N. 1934. Curious things about Guam. The faniji. Guam Recorder 11:194-195.
- Marshall, A.G. 1983. Bats, flowers, and fruit: evolutionary relationships in the Old World. Biol. J. Linn. Soc. 22:115-135.
- Marshall, A.G. 1985. Old World phytophagus bats (Megachiroptera) and their food plants: a survey. Zool J. Linn. Soc. 83:351-369.
- Payne, N.H., T.O. Lemke, and G.J. Wiles. in prep. Fruit bat populations in the northern Mariana Islands, Western Pacific.
- Payne, N.H. 1985. Personal communication to the U.S. Fish and Wildlife Service. East Bursea Farm, Holme-on-Spaulling Moor, York YO4 4DB, United Kingdom.
- Perez, G.S.A. 1972. Observations of Guam bats. Micronesica 8:141-149.
- Perez, G.S.A. 1985. Personal communication to the U.S. Fish and Wildlife Service. Division of Aquatic and Wildlife Resources, Department of Agriculture, P.O. Box 2950, Agana, Guam 96910.

- Safford, W.E. 1905. The useful plants of the island of Guam. Contrib. U.S. Natl. Herb. 9:1-416.
- Safford, W.E. 1910. A year on the island of Guam, extracts from the notebook of a naturalist on the island of Guam. I-XXV. Micronesian Area Research Center, Univ. Guam, Mangilao.
- Savidge, J.A. 1986. The role of disease and predation in the decline of Guam's avifauna. Ph.D. thesis, Univ. of Illinois, Urbana-Champaign, Illinois.
- Stone, B.C. 1970. The flora of Guam. Micronesica 6:1-659.
- Tate, G.H.H. 1934. Bats from the Pacific Islands, including a new fruit bat from Guam. Amer. Mus. Novit., No. 713.
- U.S. Department of Commerce. 1982. Number of inhabitants. Part 54. Guam. In 1980 census of population, Vol. 1, Chap. A. Pages 1-15. U.S. Govt. Printing Office, Washington, D.C.
- U.S. Fish and Wildlife Service. 1984. Endangered and threatened wildlife and plants; determination of endangered status for seven birds and two bats of Guam and the Northern Mariana Islands. Federal Register 49(167):33881-33885.
- Wheeler, M.E., and C.F. Aguon. 1978. The current status and distribution of the Mariana fruit bat on Guam. Aquatic Wildl. Resources Div. Tech. Rep. No. 1.
- Wheeler, M.E. 1979a. Study of the fruit bat. In Guam Aquatic and Wildlife Resources Division Annual Report, FY 1979. Pages 230-260. Dept. of Agriculture, Agana, Guam.
- Wheeler, M.E. 1979b. The Mariana fruit bat: management history, current status and future plans. Cal.-Neva. Wildl. Trans. 1979:149-165.
- Wheeler, M.E. 1980. Fruit bat abundance, phenology of fruiting, and interspecific associations in the limestone forest of Guam. In Guam Aquatic and Wildlife Resources Division Annual Report, FY 1980. Pages 254-303. Dept. of Agriculture, Agana, Guam.
- Wheeler, M.E. 1980. The status of the Mariana fruit bat on Saipan, Tinian, and Rota. 'Elapaio 40:109-113.
- Wiles, G.J. 1981a - 1984a. Movement patterns and habitat utilization of Mariana fruit bats. In Aquatic and Wildlife Resources Division Annual Reports, FY 1981 - 1984. Dept. of Agriculture, Guam.

Wiles, G.J. 1981b - 1984b. The current status, distribution and natural history of Mariana fruit bats. In Guam Aquatic and Wildlife Resources Division Annual Reports, FY 1981 - 1984. Dept. of Agriculture, Guam.

Wiles, G.J. 1985. Personal communication to the U.S. Fish and Wildlife Service. Division of Aquatic and Wildlife Resources, Department of Agriculture, P.O. Box 2950, Agana, Guam 96910.

Wiles, G.J. in prep. The status of fruit bats on Guam.

Wiles, G.J., and N.H. Payne. in press. The trade in fruit bats on Guam and other Pacific islands. Biol. Conserv.

Woodside, D.H. 1958. Fish and wildlife investigation. Dept. of Agriculture, Guam.

Yamashina, Y. 1932. New subspecies of bats from the mandated south Pacific islands. Trans. Nat. Hist. Soc. Formosa 22(121):240-241. (In Japanese).

III. IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for this recovery program. It is a guide to meet the objectives of the Recovery Plan for the Mariana fruit bat and the little Mariana fruit bat, as elaborated upon in Part II, Action Narrative Section. This table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible to perform these tasks, a time-table for accomplishing these tasks, and the estimated costs to perform them. Implementing Part III is the action of the recovery plan, that when accomplished, will satisfy the prime objective. Initiation of these actions is subject to the availability of funds.

Priorities in Column 1 of the following implementation schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam.

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
	1	1111	Regularly patrol Public and private lands for bat poaching.	Ongoing	GAG	750	50	50	50	50	
	1	1112	Continue to monitor illegal hunting activities presently occurring.	Ongoing	GAG	37.5	2.5	2.5	2.5	2.5	
	1	1113	Interview former hunters to learn more about hunting techniques.	10	GAG	20	2	2	2	2	
7/4	1	1121	Increase awareness of military security forces about illegal hunting of fruit bats.	Ongoing	FWS-ENF* GAG USAF USN	15 15 15 15	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	
	1	1122	Have military security forces contribute to patrol efforts for illegal hunters	Ongoing	USAF* USN	15 15	1 1	1 1	1 1	1 1	
	1	113	Federal wildlife enforcement efforts	Ongoing	FWS-ENF	495	33	33	33	33	
	1	1141	Develop & implement a multi-agency anti- poaching strategy	1	FWS-ENF GAG* USAF USN	2.5 2.5 2.5 2.5					
	1	1142	Meet periodically to review effectiveness & refine strategy.	Ongoing	FWS-ENF GAG* USAF USN	15 15 15 15	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam.

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
1	115	Have Guam Police Department report bat poaching.	Ongoing	GPD GAG*	37.5 37.5	2.5 2.5	2.5 2.5	2.5 2.5	2.5 2.5	2.5 2.5	
1	116	Aggressively prosecute fruit bat poachers.	Ongoing	FWS-ENF USA USDCG GAG SCG*	30 30 30 30 30	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	
		Cost Needs 1 (Prevent poaching)			1687.5	112.5	112.5	112.5	112.5	112.5	
1	121	Determine the extent of predation on fruit bats by brown tree snake	2	FWS-RES GAG*	40 100						
1	1221	Investigate the biology & ecology of brown tree snakes	10	FWS-RES GAG*	800 800	80 80	80 80	80 80	80 80	80 80	
1	1222	Develop and test trapping methods for snakes	8	FWS-RES* GAG	264 264	33 33	33 33	33 33			
1	1223	Develop and test other control methods for snakes.	8	FWS-RES* GAG	528 264	66 33	66 33	66 33			
1	1225	Prevent introduction of snakes into CNMI	Ongoing	CNMI* GAA GAG GCQ USAF USN	210 60 60 210 60 60	14 4 4 14 4 4	14 4 4 14 4 4	14 4 4 14 4 4	14 4 4 14 4 4	14 4 4 14 4 4	
1	1224	Implement a program for controlling snakes in essential habitat of fruit bats.	Ongoing	FWS-EHC GAG*	65 65	5 5	5 5	5 5	5 5	5 5	

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam.

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
		Cost Need 2 (Control Brown Tree Snake)			3850	379	379	379	214	214	
1	241	Gather & analyze data on the breeding biology of Mariana fruit bats.	10	FWS-RES GAG*	100 100	10 10	10 10	10 10	10 10	10 10	
1	242	Determine factors limiting reproductive success.	2	FWS-RES GAG*	20 20	10 10	10 10				Costs could be shared with related research.
1	243	Determine incidence & cause of infant mortality.	2	FWS-RES GAG*	30 30	15 15	15 15				
1	62	Evaluate need to list Mariana fruit bat throughout the Marianas.	1	FWS-EHC	20	20					Action pending results of petition to list fruit bat in the Northern Mariana Islands.
1	66	Investigate the possibility that little Mariana fruit bat occurs on Anathahan.	2	FWS-RES CNMI*	20	10 10	10 10				
2	221	Continue to gather data on use of foods.	Ongoing	GAG	75	5	5	5	5	5	
2	222	Determine the phenology of bat foods.	Ongoing	GAG	75	5	5	5	5	5	
2	61	Monitor status & distribution of fruit bats in the Commonwealth of the Northern Mariana Islands.	Ongoing	CNMI	375	25	25	25	25	25	

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam.

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
2	65	Determine taxonomic status of Mariana fruit bat on islands north of Saipan.	8	FWS-RES* SI	160 160	20 20	20 20	20 20			
2	11141	Determine identity & origin of imported fruit bats.	Cont.	FWS-ENF* GAG	14 14	5 5	1 1	1 1	1 1	1 1	
2	11142	Establish appropriate regs on the fruit bat import trade on Guam.	1	GAG	5	5					
2	211	Conduct additional field studies to determine geographical areas occupied by bats.	2	GAG	10	5	5				
2	212	Develop detailed descriptions of occupied habitats & map these areas.	1	GAG	25			25			
2	23	Determine movement patterns of fruit bats on Guam.	2	GAG	60			30	30		
2	51	Conduct periodic surveys of abundance & distribution of bats.	Cont.	GAG	48			6	6	6	
2	52	Continue to gather data on roosting bats.	Cont.	GAG	40			5	5	5	
2	53	Improve survey techniques.	2	GAG	10			5	5		

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam.

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
48	2 54	Determine the extent of inter-island movements by fruit bats.	3	GAG* CNMI	22			10	6	6	
		Cost Need 3 (Species research)			1433	205	172	178	109	74	
		Secure essential habitat									
	2 3111	Andersen Air Force Base	2	FWS-EHC USAF*	10 10	5 5	5 5				
	2 3211	Mergagan Point to Pajon Point	2	FWS-EHC GAG*	10 10	5 5	5 5				
		Conduct baseline surveys									
	2 3112	Andersen Air Force Base	1	FWS-EHC USAF GAG*	3 3 5		3 3 5				
	2 3212	Mergagan Point to Pajon Point	1	FWS-EHC GAG*	3 5		3 5				
		Develop management plans									
	2 3113	Andersen Air Force Base	1	FWS-EHC USAF* GAG	1 3 1		1 3 1				
	2 3213	Mergagan Point to Pajon Point	1	FWS-EHC GAG*	1 2		1 2				

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam.

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
Implement management Plans											
49	2	3114 Andersen Air Force Base	Cont.	FWS-EHC USAF* GAG	16 32 24			2 4 3	2 4 3	2 4 3	
	2	3214 Mergagan Point to Pajon Point	Cont.	FWS-EHC GAG*	16 32			2 4	2 4	2 4	
	3	41 Determine impact of introduced ungulates on essential habitats & take corrective action, if necessary.	10	GAG	140	50	10	10	10	10	
	3	42 Determine impacts of introduced plants, plant diseases, and insects on essential habitat.	5	GAG	150	30	30	30	30	30	
	3	43 Determine need and develop techniques to establish plantings of food trees for fruit bats.	5	GAG	50	10	10	10	10	10	
	3	44 Determine criteria for buffer zones of vegetation needed to protect essential habitat of bats.	5	GAG* GPR USAF USN	10 5 5 5	2 1 1 1	2 1 1 1	2 1 1 1	2 1 1 1	2 1 1 1	

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam.

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
Secure essential habitat for											
50	3 3121	Naval Facility	2	FWS-EHC USN*	2 2			1 1		1 1	
	3 3131	Naval Communication Area Master Station	2	FWS-EHC USN*	2 2			1 1		1 1	
	3 3141	Ague Point to Amantes Point	2	FWS-EHC USN* FAA USAF	2 2 2 2			1 1 1 1		1 1 1 1	
	3 3151	Naval Magazine and Naval Reservation	2	FWS-EHC USN*	2 2			1 1		1 1	
	3 3221	Achae Point to Falcona Beach	2	FWS-EHC GAG*	2 2			1 1		1 1	
	3 3231	Janum Point	2	FWS-EHC GAG*	2 2			1 1		1 1	
	3 3241	Sinaje, Agat area	2	FWS-EHC GAG*	2 2			1 1		1 1	
	3 3251	Amantes Point	2	FWS-EHC GAG*	2 2			1 1		1 1	
	3 3311	Anao Point to Campanaya Point	2	GPR* GLM GAG	2 2 2			1 1 1		1 1 1	
	3 3321	Falcona Beach	2	GLM* GAG	2 2			1 1		1 1	
	3 3331	Puntan Dos Amantes Park	2	GPR* GAG	2 2			1 1		1 1	
	3 3341	Bolanos Conservation Reserve	2	GPR* GAG	2 2			1 1		1 1	

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam.

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
3	3351	Territorial-owned land in Agat	2	GLM* GAG GPR	2 2 2		1 1 1	1 1 1			
		Conduct base line surveys for bats on									
3	3122	Naval Facility	1	FWS-EHC USN GAG*	1 1 1			1 1 1			
3	3132	Naval Communication Area Master Station	1	FWS-EHC USN GAG*	1 1 1			1 1 1			
3	3142	Ague Point to Amantes Point	1	FWS-EHC USN GAG* USAF	1 1 1 1			1 1 1 1			
3	3152	Naval Magazine and Naval Reservation	1	FWS-EHC USN GAG*	1 1 1			1 1 1			
3	3222	Achae Point to Falcona Beach	1	FWS-EHC GAG*	1 1			1 1			
3	3232	Janum Point	1	FWS-EHC GAG*	1 1			1 1			
3	3242	Sinaje, Agat area	1	FWS-EHC GAG*	1 1			1 1			
3	3252	Amantes Point	1	FWS-EHC GAG*	1 1			1 1			
3	3312	Anao Point to Campanaya Point	1	GAG	1			1			

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam.

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
	3	3322	Falcona Beach	1	GAG	1			1		
	3	3332	Puntan Dos Amantes Park	1	GAG	1			1		
	3	3342	Bolanos Conservation Reserve	1	GAG	1			1		
	3	3352	Territorial-owned land in Agat	1	GAG	1			1		
		Develop management plans for									
52	3	3123	Naval Facility	1	FWS-EHC USN* GAG	1 1 1			1 1 1		
	3	3133	Naval Communication Area Master Station	1	FWS-EHC USN* GAG*	1 1 1			1 1 1		
	3	3143	Ague Point to Amantes Point	1	FWS-EHC USN* GAG USAF FAA	1 1 1 1 1			1 1 1 1 1		
	3	3153	Naval Magazine and Naval Reservation	1	FWS-EHC USN* GAG	1 1 1			1 1 1		
	3	3223	Achae Point to Falcona Beach	1	FWS-EHC GAG*	1 1			1 1		
	3	3233	Janum Point	1	FWS-EHC GAG*	1 1			1 1		

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
53	3	3243	Sinaje, Agat area	1	FWS-EHC GAG*	1 1		1 1			
	3	3253	Amantes Point	1	FWS-EHC GAG*	1 1		1 1			
	3	3313	Anao Point to Campanaya Point	1	GAG			1			
	3	3323	Falcona Beach	1	GAG			1			
	3	3333	Puntan Dos Amantes Park	1	GAG			1			
	3	3343	Bolanos Conservation Reserve	1	GAG			1			
	3	3353	Territorial-owned land in Agat	1	GAG			1			
	Implement management plans for										
	3	3124	Naval Facility	Cont.	FWS-EHC USN* GAG	7 14 7			1 2 1	1 2 1	
	3	3134	Naval Communication Area Master Station	Cont.	FWS-EHC USN* GAG	7 14 7			1 2 1	1 2 1	
	3	3144	Ague Point to Amantes Point	Cont.	FWS-EHC USN* GAG USAF FAA	7 14 7 7 7			1 2 1 1 1	1 2 1 1 1	
	3	3154	Naval Magazine and Naval Reservation	Cont.	FWS-EHC USN* GAG	7 14 7			1 2 1	1 2 1	

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
54	3	3224	Achae Point to Falcona Beach	Cont.	FWS-EHC GAG*	7 14			1 2	1 2	
	3	3234	Janum Point	Cont.	FWS-EHC GAG*	7 14			1 2	1 2	
	3	3244	Sinaje, Agat area	Cont.	FWS-EHC GAG*	7 14			1 2	1 2	
	3	3254	Amantes Point	Cont.	FWS-EHC GAG*	7 14			1 2	1 2	
	3	3314	Anao Point to Campanaya Point	Cont.	GAG	7			1	1	
	3	3324	Falcona Beach	Cont.	GAG	7			1	1	
	3	3334	Puntan Dos Amantes Park	Cont.	GAG	7			1	1	
	3	3344	Bolanos Conservation Reserve	Cont.	GAG	7			1	1	
	3	3354	Territorial-owned land in Agat	Cont.	GAG	7			1	1	
		Cost Need 4 Secure & manage essential habitat			910	115	132	153	105	105	
		Common Wealth of Northern Mariana Islands									
	3	63	Increase enforcement of laws protecting fruit bats.	Ongoing	CNMI	150	10	10	10	10	
	3	64	Develop a public awareness campaign in CNMI	Cont.	CNMI	210			30	30	

55

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
3	7	Develop a cooperative agreement between the territory of Guam, CNMI, and U.S. Fish and Wildlife Service.	1	FWS-EHC* FWS-ENF GAG CNMI	8 5 7 7				8 5 7 7		
3	213	Determine minimum area of suitable habitat needed to sustain a viable population of bats.	2	GAG	20				10	10	
3	8	Develop a public awareness program on Guam.	Cont.	GAG	101				50		36 Minimal effort, more needed.
3	91	Determine the proper time to start a reintroduction program for bats.	2	FWS-EHC* GAG	5 5				2.5 2.5	2.5 2.5	
3	92	Determine the source of bats for a reintroduction program.	2	FWS-EHC* GAG	5 5				2.5 2.5	2.5 2.5	
3	93	Determine the number and location of sites for reintroduction	1	GAG	2.5				2.5		

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
3	94	Determine whether a captive breeding program can produce fruit bats for release.	3	FWS-EHC* GAG	7.5 7.5				2.5 2.5	2.5 2.5	
		Cost Need 5			545.5	10	10	10	144.5	101	
		Determine recovery objectives/reintroduce if necessary									
		Total Yearly Costs			8426	821.5	805.5	832.5	685	606.5	

KEY FOR RESPONSIBLE AGENCIES

CNMI = Commonwealth of the Northern Mariana Islands,
Division of Fish and Wildlife.

FAA = Federal Aviation Administration.

FWS-EHC = United States Fish and Wildlife Service, Region 1,
Endangered Species.

FWS-ENF = United States Fish and Wildlife Service, Region 1,
Law Enforcement.

FWS-RES = United States Fish and Wildlife Service, Region 1,
Research.

GAA = Guam Airport Authority.

GAG = Guam Department of Agriculture.

GCQ = Guam Customs and Quarantine Division,
Department of Commerce.

GLM = Guam Department of Land Management.

GPD = Guam Police Department.

GPR = Guam Department of Parks and Recreation.

SCG = Superior Court of Guam.

Recovery Plan Implementation Schedule for the Mariana Fruit Bat and Little Mariana Fruit Bat on Guam

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
--------------------	-----------	---------------------	--------------------------------	----------------------	---------------	---------	---------	---------	---------	---------	----------

SI = Smithsonian Institute.

USA = United States Attorney.

USAF = United States Air Force.

USDCG = United States District Court of Guam.

USN = United States Navy.

APPENDICES

APPENDIX A

ESSENTIAL HABITAT

Essential habitat for Mariana fruit bats has been delineated in northern and southern Guam (Figures 3, 4). This bat species was historically found throughout much of the island but in recent times has become restricted to forested clifflines in northern Guam and forested ravines and hillsides in southern Guam. Approximately 90 percent of the island's present fruit bat population occurs in the Andersen Air Force Base (Anderson AFB) area. Preservation of essential forest habitat is necessary for the full recovery of Mariana fruit bats on Guam. The areas designated in this plan contain known roosting and foraging sites for fruit bats. In addition, the maintenance of large tracts of forest, such as those on Andersen AFB, is important by helping to isolate fruit bats from illegal hunting.

Because little information exists on the habitat use and distribution of little Mariana fruit bat, it is difficult to determine essential habitat for this species. However, it seems likely that the areas delineated for the Mariana fruit bat will also be of great value to any remaining little Mariana fruit bat.

In northern Guam, essential habitat consists of cliffline forest and a large inland tract of forest on Anderson AFB. Essential forests occur within 1 km of the cliffline fringing the island's northwest coast between Amantes Point and the northern boundary of Naval Communications Areas Master Station. Lands in this strip that have been cleared of forest have been omitted from essential habitat designation. Essential habitat also includes all forests north of the southern boundary of AAFB from Naval Communications Area Master Station to Salisbury Junction and north of Marine Drive, Perimeter Road and 32D Street on Anderson AFB. It further includes all forests within 1 km of the cliffline from north of the Weapons Storage Area to Pati Point and south to the base's eastern boundary near Anao Point. Further south along Guam's eastern coast, essential habitat includes all territorially owned lands and a small privately-owned plot south to Campanaya Point. This area generally includes all land below the cliffline and certain stands of forest found inland from it.

As specified in the goals of this plan, a viable population of Mariana fruit bats with at least one colony must be re-established in southern Guam before the species can be considered fully recovered. Thus, essential habitat has also been designated for this area of the island. This habitat includes all forests on Naval Magazine and Naval Reservation (Fena Valley Watershed). Two other pieces of land, one of which is privately-owned and the second of which is territorially-owned, occur above the 800-foot

contour along the western boundaries of both Naval properties. The Balanos conservation Reserve has also been included as essential habitat. These lands also represent a valuable watershed for southern Guam.

APPENDIX B

INDIVIDUALS CONTACTED DURING TECHNICAL REVIEW

*Edward W. Eckhoff Division of Law Enforcement Natal Marine Fisheries Service U.S. Department of Commerce P.O. Box 3238 Agana, Guam 96910	*Adrian G. Marshall Institute of Southeast Asian Biology c/o Dept. of Zoology University of Aberdeen Aberdeen AB9 2TN United Kingdom
*John Engbring U.S. Fish & Wildlife Service 300 Ala Moana Blvd. P.O. Box 50167 Honolulu, HI 96850	*Colonel Billy E Sachse HQ, 43rd Combat Support Group (SAC) Anderson Air Force Base APO San Francisco 96334
Margie Falanruw The Yap Institute of Natural Science P.O. Box 215 Yap, W.C.I. 96943	*Dr. Chris Tidemann Dept. of Zoology Australian National University G.P.O. Box 4 Camberra, ACT 2601 AUSTRALIA
*Commodore Chauncey F. Hoffman U.S. Pacific Fleet Commander Naval Base Guam Marianas Commander Naval Base Guam FPO San Francisco 96630	*Dr. Merlin Tuttle Bat Conservation International c/o Milwaukee Public Museum 800 West Wells Street Milwaukee, WI 53233
*Thomas O. Lemke Montana Department of Fish, Wildlife, and Parks P.O. Box 597 Thompson Falls, MT 59873	*Michael E. Wheeler Dept. of Environmental Conservation 437 E. Street, Second Floor Anchorage, AK 99051

*Comments were received.

APPENDIX C

AGENCIES CONTACTED DURING AGENCY REVIEW

*Commodore Chauncey F. Hoffman U.S. Pacific Fleet Commander Naval Forces Mariana Commander Naval Base Guam FPO San Francisco 96630	*Colonel Billy E. Sachse HQ 43rd Combat Support Group (SAC) Andersen Air Force Base APO San Francisco 96334
Regional Director National Marine Fisheries Service Southwest Regional Office 300 Ferry St., Room 2016 Terminal Island, CA 90731	*Director U.S. Fish & Wildlife Service Dept. of the Interior Washington, D.C. 20240
Nicholas M. Guerrero Director Dept. of Natural Resources Capitol Hill Saipan, CM 96950	*The HON Pedro Tenorio Governor Commonwealth of the Northern Mariana Islands Saipan, CM 96950
*The HON Ricardo Bordallo Governor of Guam Office of the Governor Agana, Guam 96910	*Paul B. Souder Director Bureau of Planning P.O. Box 2950 Agana, Guam 96910
*James B. Branch Administrator Guam Environmental Protection Agency P.O. Box 2999 Agana, Guam 96910	*John T. Palomo Director Dept. of Parks & Recreation 490 Naval Hospital Road Agana Hgts., Guam 96919
Elizabeth P. Torres Director Dept. of Agriculture Atten: Division of Aquatic & Wildlife Resources P. O. Box 2950 Agana, Guam 96910	*Wilfred Leon Guerrero Dean, College of Agriculture and Life Sciences Univ. of Guam Station
*Resident Director Federal Aviation Administration Route 008 Finegayan, Guam 96912	*Chief of Police Guam Police Department 287 West O'Brien Drive Agana, Guam

Dale Rush
Animal Plant Health Inspection
Service
Plant Protection & Quarantine
U.S. Department of Agriculture
96630 P.O. Box 8769
Tamuning, Guam 96911

Carlos Noguez
Chief
Division of Forestry and
Soil Resources
Department of Agriculture
P.O. Box 2950
Agana, Guam 96910

Arnold Palacios
Chief
Division of Fish and
Wildlife
Department of Natural
Resources
Saipan, CM 96950

*Rufo Lujan
Director
Department of Land Management
P.O. Box 2950
Agana, Guam 96910

*Captain Thomas E. Stone
Commanding Officer
US NAVCOM Area, Master
Station
FPO San Francisco

LT Commander Steven Feely
Commanding Officer
U.S. Naval Facility
Box 115
FPO San Francisco 96630

Captain Fred M. Williamson
Commanding Officer
U.S. Naval Station
Box 152
FPO San Francisco
96339-1000

*J.R. Faunce
Commander
Civil Engineer Corps
U.S. Navy
Head, Facilities
Planning Department
Pearl Harbor, HI
96860-7300

*Comments were received.